IN THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:	M. Barrera et al.	
Serial No:	09/675,860	Group Art Unit: 3752
Filed:	September 29, 2000	Examiner: Christopher S. Kim
For:	APPARATUS AND METHOD OF EFFECTIVE FLUID INJECTION AND VAPORIZATION FOR CHEMICAL VAPOR DEPOSITION APPLICATION	Date: July 2, 2009

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PAPER TO AMEND APPEAL BRIEF SUMMARY OF THE CLAIMED SUBJECT MATTER

Appellants submit this paper to amend the Appeal Brief pursuant to a June 3, 2009 Notification of Non-Compliant Appeal Brief.

An Order returning the undocketed appeal to the Examiner was mailed on May 22, 2009 for the following reason: the "Summary of Claimed Subject Matter" was deemed deficient because it did not separately map independent claims 1, 13, 28 and 31 to the specification.

Appellants have endeavored to address this issue herein, and respectfully submit that this Paper puts the Appeal Brief submittal in a condition for acceptance.

(Revised) SUMMARY OF THE CLAIMED SUBJECT MATTER

In chemical vapor deposition (CVD), reactants and other dopants are injected in vapor phase over substrates for deposition thereon. However, several problems are created by the physical properties that such materials undergo within the CVD chamber. (Specification, page 1, lines 9-15.)

Referring to Fig. 1, prior art has focused on pre-mixing solutions within a heated injector manifold 30 and transporting such pre-mixed fluids to a mixing chamber 35. (Specification, page 7, lines 3-18.) Once mixed, the mixture enters showerhead 26 through a ceramic tube 25, and then the solution vaporizes over a substrate for efficient mixing and deposition thereon. (Specification, page 7, lines 18-21; and page 3, lines 2-6.) However, certain precursors and dopants are not fully vaporized by such methods, such as tetraethylorthosilicate (TEOS), which does not fully atomize upon entering the gas manifold. This incomplete atomized of liquids entering into the gas manifold leads to inefficient deposition on the process wafers with the potential risk of carrier gas material landing on the wafer. (Specification, page 2, line 28 to page 3, line 25.)

The present invention is aimed at overcoming the above problems of pre-mixing, and then mixing, followed by the transportation of such mixed solutions to a chamber for injection therein. In so doing, the invention presents a delivery apparatus in combination with a chemical vapor deposition chamber that avoids the stage of pre-mixing of solutions prior to introduction into mixing chamber 35 for the completion of mixing.

In particular, the present invention avoids pre-mixing of solutions by providing a chemical vapor deposition chamber in combination with a delivery apparatus, particularly a cross-flow injector, which includes an inlet nozzle, a throat

region and an exit nozzle. (Specification, page 8, line 13 to page 9, line 8; claims 1, 13, 10, 21, 28 and 31.)

Support for Independent Claim 1

Independent Claim 1 teaches a chemical vapor deposition chamber for processing a semiconductor substrate. (Specification, p.3, ll.26-29.) The combination of a chemical vapor deposition chamber and the cross-flow injector (Claims 1, 13, 28 and 31) is amply supported by the specification. First, the problem that the invention intends to address has been described as one of processing and fluid delivery within a chemical vapor deposition chamber:

> The introduction of deposition reactants and other dopants has posed technical problems in the art that are governed, in part, by the physical properties these materials undergo *within the chemical vapor deposition process*. Some resolutions to these problems have incorporated direct injection of liquid solutions to introduce a deposition reactant *into a CVD deposition chamber*. (Specification, p.1, ll.12-17 (emphasis added)); and

> The present methods in the art used to inject a carrier fluid (gas) such as tetraethylorthosilicate (TEOS) along with precursors and dopants into the gas manifolding *leading to the reactor chamber* is inefficient and does not fully vaporize the injected fluids, especially the TEOS. (Specification, p.2, ll.16-19 (emphasis added))

Second, the invention is fully and completely described as it relates specifically to an application for chemical vapor deposition for semiconductor substrates, for example, identifying a carrier fluid (gas), tetraethylorthosilicate (TEOS), which is used for such applications.

> This invention is predominately used in a TEOS application, but may be valid for any liquid precursor and dopant liquids being injected into a process chamber. (Specification, p.13, ll.9-11; claims 5 and 17.)

A second limitation of claim 1 is that the delivery apparatus delivers the plurality of chemical vapor deposition fluids to the substrate, the apparatus being attached to, and in fluid communication with, the chamber (Specification, p.5, ll.9-

10), and having a cavity comprising an inlet nozzle, a throat region and an exit nozzle. (Specification, p.4, l.21-p.5, l.6; p.8, l.15- p.10, l.2; Claims 1, 13, 28, and 31; Figs. 2 and 3.)

The third limitation of claim 1 includes the inlet nozzle having a first diameter adapted to receive a carrier fluid, and having a first pressure and a first temperature. As noted in the Specification, the inlet nozzle 50 is used for a carrier fluid, such as O_2, N_2, or He, having a first diameter D_1, and configured to maintain a first pressure, P_1, and first temperature T_1. (Specification, page 8, lines 15-19; claims 1, 2, 13, 14, 28 and 31.)

The fourth limitation of claim 1 includes the throat region having a first and second end, connected to the inlet nozzle at the first end (Figs. 2-4; Specification, p.5, ll.4-7), the throat region having a second diameter less than the first diameter and adapted to receive the carrier fluid from the inlet nozzle (Specification, p.8, ll.19-21; Fig. 2), the throat region having a second pressure lower than the first pressure and a second temperature (Specification, p.8, ll.23-25; Fig. 2), and having a first and a second aperture adjacent to the first and second ends for injecting (Specification, p.8, ll.26-29), respectively, a first and a second chemical vapor deposition dopant into the throat region to allow for atomization of the first and second chemical vapor deposition dopants by the carrier fluid and mixing of the atomized first and second chemical vapor deposition dopants with the carrier fluid (Specification, p.9, ll.8-12). Inlet ports 46 and 48 are connected to throat region 44 for injecting liquids 1 and 2 therein, whereby at the point of introduction into throat 44 are atomized by the fluid flow of the carrier fluid through the inlet nozzle 50 such that mixing occurs in the throat and at the exit nozzle 42. (Specification, page 8, l.29-p.9, l.4; claims 2, 8-10, 14, 20, and 21.)

The remaining limitation of claim 1 includes the exit nozzle, which is connected to the throat region at the second end, having an exit pressure lower than the second pressure and a third temperature, the exit nozzle having a third diameter greater than the second diameter to allow for a substantial decrease in pressure from the first pressure to the exit pressure (Specification, p.4, ll.23-27), and configured to introduce the mixed atomized first and second chemical vapor deposition dopants and the carrier fluid in the chemical vapor deposition chamber. Essentially, the inlet nozzle 50 tapers to a narrower throat region 44, operating at Mach 1.0, that has a second diameter D_2 (smaller than D_1), where the fluid undergoes a second pressure, P_2 (lower than P_1 and higher than a third pressure P_3 at exit nozzle 42), and temperature, T_2. (Specification, page 8, lines 19-25; claims 1, 2, 3, 7, 8, 13, 14, 15, 16, 19, 28 and 31.)

Support for Independent Claim 13

Independent Claim 13 teaches the combination of a chemical vapor deposition chamber and an apparatus for delivering a plurality of chemical vapor deposition fluids to the chemical vapor deposition chamber. (Specification, p.1, ll.12-17; p.2, ll.16-19; p.13, ll.9-11.)

A second limitation of claim 13 is that the delivery apparatus delivers the plurality of chemical vapor deposition fluids to the substrate, the apparatus being attached to, and in fluid communication with, the chamber (Specification, p.5, ll.9-10), and having a cavity comprising an inlet nozzle, a throat region and an exit nozzle. (Specification, p.4, l.21-p.5, l.6; p.8, l.15- p.10, l.2; Claims 1, 13, 28, and 31; Figs. 2 and 3.)

The inlet nozzle having a first diameter adapted to receive a carrier fluid, and having a first pressure and a first temperature, the carrier fluid comprising a process

compatible gas selected from the group consisting of O_2, N_2, and He. (Specification, page 8, lines 15-19; claims 1, 2, 13, 14, 28 and 31.)

Another limitation of claim 13 is for the throat region having a first and second end, connected to the inlet nozzle at the first end (Figs. 2-4; Specification, p.5, ll.4-7), the throat region having a second diameter less than the first diameter, and adapted to receive the carrier fluid from the inlet nozzle (Specification, p.8, ll.19-21), the throat region having a second pressure and a second temperature (Specification, p.5, ll.13-25; p.8, ll.19-21) and having a first and a second aperture adjacent to the first and second ends for injecting (Specification, p.8, ll.26-29), respectively, a first and a second chemical vapor deposition fluid into the throat region to allow for atomization of the first and second chemical vapor deposition fluid by the carrier fluid and mixing of the atomized first and second chemical vapor deposition fluid with the carrier fluid, the first and second chemical vapor deposition fluids comprise fluids selected from the group consisting of precursors and dopants. (Specification, p.9, l.8-12; p.3, ll.26-29; Abstract, ll.11-12.)

The last limitation of claim 13 includes having the exit nozzle connected to the throat region at the second end, having the second diameter, the exit nozzle configured to maintain the second pressure and the second temperature, such that the exit nozzle is an extension of the throat region consisting of the same dimensions as the throat region (Specification, p.5, ll.21-25; p.10, ll.27-29), the exit region configured to introduce the atomized first and second chemical vapor deposition fluid and the carrier fluid in the chemical vapor deposition chamber.

Further, several injection points may be introduced into the throat region 44 (such as inlets 46 and 48 for liquids 1 and 2) so that more than one liquid may be injected simultaneously, thus allowing for the doping of films while not requiring a

pre-mixing of these liquids. (Specification, page 9, lines 5-8; claims 10 and 21.) That is, no pre-mixing of liquids 1 and 2 occurs prior to their introduction into throat region 44 in the present apparatus.

As shown in Figs. 2 and 3A, the exit nozzle 42 may have a diameter D_3 that is greater than the diameter D_2 of the throat region 44 (specification, page 9, lines 11-17; claims 1, 29 and 31), or alternatively as shown in Fig. 6, have substantially the same diameter as that of the throat 44, D_2, (specification, page 10, lines 27-29; claims 13 and 30). Regardless, a feature of the invention is that more than one fluid may be introduced simultaneously into a chemical vapor deposition chamber through the cross-flow injector without pre-mixing the fluids. This provides for the fluid to be introduced into the low pressure process chamber and become efficiently atomized without concern of cavitation in the fluid supply lines. (Specification, page 14, lines 14-21; claims 1, 4, 5, 7, 8, 10, 13, 16, 17, 19, 21, 26, 27, 28 and 31.)

An inlet edge 56 is designed to be at an angle in the range of 40° to 60° with respect to the horizontal. Preferably, the inlet edge 56 is approximately 45°. An Exit edge 54, is designed to be at an angle in the range of 20° to 40° with respect to the horizontal, and preferably approximately 30°. (Specification, p.9, ll.19-23; Figs. 3A and 3B; claims 2, 12, and 14.)

The throat region may be configured to operate at a critical Mach number of 1.0. (Specification, p.11, ll.15-28; claims 3 and 15.)

In addition to the above-cited Specification support, additional support for the distinguishing limitations that separate independent claims 1, 13, 28 and 31 is provided below:

The limitations of claim 13 differ from those of claim 1 in pertinent part insomuch as claim 13 identifies the carrier fluid be comprised of a process

compatible gas selected from the group consisting of O_2, N_2, and He. (Specification, p.8, ll.23-25.) Claim 13 further identifies first and second chemical vapor deposition fluids to include fluids selected from the group consisting of precursors and dopants. (Specification, p.2, ll.16-19; p.3, ll.26-29; p.5, ll.6-7.) Last, claim 13 defines the exit nozzle to be an extension of the throat region consisting of the same dimensions as the throat region. (Specification, p.5, ll.23-25; p.10, ll.27-29; Fig. 6.)

Support for Independent Claim 28

The limitations of claim 28 differ from those of claim 1 and 13 in pertinent parts insomuch as claim 28 more broadly identifies the exit nozzle as having an exit pressure, without limiting the exit pressure to be lower than the second pressure. Claim 28 further identifies the chemical vapor deposition chamber being adapted to receive the mixture of atomized first and second ***dopants*** with the carrier fluid from the exit nozzle of the cavity. (Specification, p.14, ll.20-22.)

Specifically, claim 28 differs from claim 13 in the following limitation: the throat region, having a first and second end, is connected to the inlet nozzle at the first end, the throat region having a second diameter less than the first diameter, and adapted to receive the carrier fluid from the inlet nozzle, the throat region having a second pressure and a second temperature and having a first and a second aperture adjacent to the first and second ends for injecting, respectively, a first and a second chemical vapor deposition dopants into the throat region (Specification, p.5, ll.6-7) to allow for atomization of the first and second chemical vapor deposition dopants by the carrier fluid and mixing of the atomized first and second chemical vapor deposition dopants with the carrier fluid.

A further limitation of claim 28 is that the chemical vapor deposition chamber is adapted to receive the mixture of atomized first and second chemical

vapor deposition dopants with the carrier fluid from the exit nozzle of the cavity. (Specification, p.7, ll.18-22; p.9, ll.2-4.)

Support for Independent Claim 31

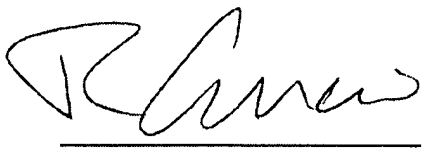
The limitations of claim 31 that distinguish claim 31 over claims 1, 13, and 28 include calling for the limitation that the apparatus be physically capable sustaining within the caustic environment when introducing TEOS. (Specification, p.7, ll.18-21; p.13, ll.9-12.)

SUMMARY

It is respectfully submitted that the above "Summary of the Claimed Subject Matter" meets the requirements of 37 C.F.R. § 41.37(c)(v).

Accordingly, Appellants respectfully submit that the claimed invention, as a whole, is not obvious over the cited prior art and that claims 1-5, 7-10, 12-17, 19-21 and 26-31 are clearly patentable over the references. The Final Rejection should be reversed and the claims should be allowed to issue.

Respectfully submitted,



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